

Chancellor (C. W.)



Reprinted from the Transactions of the Sanitary Convention of Maryland, 1883

(STATE BOARD OF HEALTH REPORT, 1884).

SEWERAGE OF CITIES

A Reply to the Paper of Col. George E. Waring, C. E., of Newport, R. I., on "The Liernur System of Sewerage for Baltimore."

*An important question, involving the interests of
Health, Commerce and Agriculture.*

BY

C. W. CHANCELLOR, M. D.,

SECRETARY STATE BOARD OF HEALTH OF MARYLAND.

box 86



Reprinted from the Transactions of the Sanitary Convention of Maryland, 1883

(STATE BOARD OF HEALTH REPORT, 1884).

SEWERAGE OF CITIES

*A Reply to the Paper of Col. George E. Waring, C. E., of Newport,
R. I., on "The Liernur System of Sewerage for Baltimore."*

*An important question, involving the interests of
Health, Commerce and Agriculture.*

BY

C. W. CHANCELLOR, M. D.,

SECRETARY STATE BOARD OF HEALTH OF MARYLAND.



THE UNIVERSITY OF CHICAGO
LIBRARY

IN THE DEPARTMENT OF THE ARMY
WASHINGTON, D. C.

RECEIVED
JAN 10 1918

THE UNIVERSITY OF CHICAGO
LIBRARY

IN THE DEPARTMENT OF THE ARMY
WASHINGTON, D. C.

RECEIVED
JAN 10 1918

THE UNIVERSITY OF CHICAGO
LIBRARY

Reply to the Paper of Col. George E. Waring, C.E., of Newport, R. I.,
on "The Liernur System of Sewerage for Baltimore"--An
Important Question Involving the interests of
Health, Commerce and Agriculture.

BY C. W. CHANCELLOR, M. D.,

Secretary of the State Board of Health of Maryland.

The title of Colonel Waring's paper seems to me to be a misnomer. It should have been "A Criticism of Dr. Chancellor's Paper on Liernur's Pneumatic System of Sewerage." Be this as it may, I cheerfully comply with Col. Waring's suggestion, and publish my reply, with his paper, in the report of the proceedings of the Maryland State Sanitary Convention.

Without having entered into a very critical examination of Col. Waring's paper, I shall attempt to give my views upon the merits of the question under discussion, notwithstanding the fact that I have already published a somewhat exhaustive paper on the subject, and also a reply to the sweeping assertions of Dr. John S. Billings of the U. S. Army, concerning the Liernur system.

Col. Waring starts out with the declaration that, in discussing the Liernur system in a paper read before the Medical and Chirurgical Faculty of Maryland last spring, I "threw down the gauntlet to the engineering profession in such an emphatic way that it would be unjust to his confreres of that profession to omit such an opportunity as this (the session of the State Sanitary Convention) for parrying the thrust in the arena where it was delivered." In a letter, he further characterizes my paper as "a very savage onslaught upon his profession." Before entering upon the merits of the question, I must be permitted to say that it was very far from my thoughts or intentions to reflect "savagely," or even unpleasantly, upon any profession, and I think if this fact alone induced Col. Waring's reply to my paper, he must be hypersensitive, or at least hyper-jealous of the reputation of his profession. At the same time, I would not have it understood that I object to the most liberal criticism. I am a cordial friend to the

right of appeal from my opinions to the supreme tribunal of the public; and am equally disposed to pay all due attention to any motion for a re-hearing in my own court; or, of giving, as Col. Waring elegantly puts it, "an opportunity for parrying a thrust in the arena where it was delivered."

Col. Waring's sensitiveness still further manifests itself in the following paragraph: "As one of many engineers who have advocated and executed works that are here (in Dr. Chancellor's paper) condemned, it seems to me a duty to resist the charge of blundering and to throw the responsibility of error and false judgment on the medical authority that recommends a bad substitute for them." In this I quite agree with him, if he can substantiate the fact, which he has thus far failed to do, that the measure proposed is "a bad substitute." It will not do for the partisans of any particular scheme to expect that all opinions contrary to their own can be limited in such a manner as to leave them the power of suppressing all opposition to their particular "project." It is manifest, even at first sight, that no such limit will be set by public opinion. That truth, if it has fair play, will always triumph over error, and become the opinion of the world, is a proposition which rests upon the broadest principles of human nature, and therefore no one need fear the unveiling of *truth*.

In this connection, I am constrained to refer to the extreme unfairness of the criticism of my paper contained in the *Sanitary Engineer* of New York, November 29, 1883, with which, however, I am quite sure, Col. Waring had nothing to do. He is always frank, outspoken and courteous. In this instance the anonymous critic, who is supposed to be a "Sir Oracle" in sanitary matters, employed the press not to enlighten the public, but to accomplish his own ends, regardless alike of truth and justice. While ridicule and invective may stimulate partisans they are not likely to make one who seeks truth renounce an opinion, but usually have the contrary effect, and are therefore the least judicious weapons to be employed by sanitary journals having the interest of the health and life of the people at heart.

But to return to the paper of Col. Waring. He says that I have made many of my comments which should have been properly confined to the combined system relate to the "water-carriage" system; and therefore he thinks they are by implication applied to the separate system. While I cannot believe that the separate

system is all that could be desired, I was certainly very emphatic in expressing the opinion that it was a *great improvement* over the combined system. The chief trouble of any water-carriage system of sewerage, as I stated, lies in the question of the ultimate disposal of the noxious sewage *after it is out of the city*.

Notwithstanding Col. Waring's special plea in behalf of the Bay of Naples,* there can be no doubt that the influx of sewage matter will pollute and render noxious any harbor or stream into which it flows. It is only a question of time and quantity, and no remedy will prevent it which does not exclude all sewage waste.

At Paris the river Seine, with its immense volume and frequent flushings by torrents of storm-water, gathered as far off as the western slope of the Jura mountains, has suffered greatly from the influx of sewage matter, which was discharged into the river by two "collectors" at St. Denis and d'Asnieres, respectively, in a quantity amounting to nearly three hundred thousand cubic yards every twenty-four hours, which formed banks in the bed of the stream below the "collectors." These deposits, representing a volume of at least one hundred and eighteen thousand cubic yards of material, which had to be removed at an annual expense of more than two hundred thousand francs; and it is said that even with this expenditure "the removal has been very incomplete, and the obstruction is increasing year by year, and extending further down the river, to the serious detriment of commerce." These banks occupy more than a quarter of the bed of the river from d'Asnieres to Chatou.

So much for the obstructions occasioned in the river Seine by the sewage of Paris. As to the *pollution* of the waters "the river from Clichy to Poissy," says the director of public works, "is converted into a vast bed of fermentation and infection, and offers nothing in this part of its course but a water too impure for domestic uses, mortal to the fish, and filling the air with foetid exhalations, which are borne even to the gates of the capitol."†

*During my stay in Europe last winter I read in a French journal a letter stating that "the Bay of Naples had become a reeking cesspool from the sewage matter which flowed into it, and during the summer many of the owners or occupants of villas upon its banks had abandoned their homes in consequence of the sickening stench exhaled from the polluted waters of that once beautiful bay." Col. Waring denies the accuracy of the statement, and I shall accept his version of the matter, as I am not personally cognizant of the facts.

† Revue des Deux Mondes, 1880.

At London, where there is a tide of nearly twenty-four feet, the sewers at one time emptied into the Thames, some ten or twelve miles below the city, and that large river became a nuisance so intolerable that the government built sewers, at an expense of several millions of pounds, to carry the sewage more than twenty miles below the city. It was clearly shown by the reports of distinguished engineers, made to the Sewerage of Towns Commission, that "sewage discharged into the river two hours after high tide, reached the same point upon the next flood that the sewage did which was discharged into it two hours before the previous high tide."

At Montreal, where there is a current running at the rate of seven miles an hour, the sewage discharged into the St. Lawrence river so contaminated the locality as to be offensive to smell and injurious to health; and in one instance when a small sewer delivered its flow into a dock of La Chene Canal, which was constantly changing its contents by the passage of boats, the water became so defiled and offensive that the authorities found it necessary to construct a sewer far out into the river, and below the city.

The city of Boston had, a few years since, sewers emptying into the large rivers on its circumference, and into the harbor where the tide is twelve to fifteen feet, and although the sewage of the city was distributed over a line of many miles instead of into a contracted basin, it became so great a nuisance that a large tunnel has lately been built to remove the discharge to a point many miles down Massachusetts bay.

Many other examples of cities might be given where neither tide nor current afforded relief, but those cited are deemed quite sufficient.

The harbor of Baltimore has already been affected by the surface washing and other organic matter which passes into "The Basin," and it is a fair and irresistible deduction that should the sewage of the whole city, amounting in the aggregate to more than one million tons annually, be emptied anywhere into the Patapsco river or the upper bay, it will not only tend to obstruct the channel but will be brought back by reflux tides, converting not only the Patapsco river but all the tributaries of the upper bay "into beds of fermentation and infection," rendering their waters "too impure for domestic uses, mortal to fish, and filling the air with foetid exhalations." Indeed with such an afflux of foetid

matter it is not unsafe to predict that, in the course of time, the waters of Chesapeake bay will become a distillation of all the filth of Baltimore city.

Few men, I think, not completely blinded by prejudice will reject the evidences which exist on this point, and if such evidence can be questioned, it is in vain to look for further testimony in sanitary affairs.

Col. Waring lays great stress upon the hypothesis that "in pipe sewers properly flushed" there is no dessication and, consequently, he argues, "there can be no dislodgment of spores" developed by the fungus growths which take place in sewer pipes generally, and which even intrude to the house side of the traps of water closets, &c., and are known to give off poisonous germs. These germs are borne here and there by sewer gas, when in a dry state, and by exhalations when moist. To deny that these germs or parasites can be transmitted from and by moisture, would be to deny the theory of *miasma*, which I scarcely think a gentleman of Col. Waring's intelligence and experience will undertake to do. The fundamental error in the argument seems to be this: He contends that in the small pipe sewers "the area that is reached by the sewage is covered and flushed *too often* to become dry enough to part with its spores." The volume of sewage matter flowing in the pipes is by no means a fixed quantity, consequently there can be no uniform "area" covered by the sewage, and it is quite impossible to determine whether the flushing is sufficiently "often" and voluminous to prevent the dislodgment of the spores or not.

Continuing his criticism of my views in regard to the escape of the germs of deadly disease from sewers, Col. Waring says: "Marie-Davy found that the atmosphere of the sewers of Paris contained fewer bacteria than the atmosphere of ordinary living rooms," and he goes on to say that "their existence would, according to Dr. Chancellor's opinion, be of no consequence," etc. I am certainly at a loss to understand the force of these remarks. It is, I believe, well established that organic liquids deprived of bacteria, may have infective properties in certain cases, and on the other hand, the presence of bacteria has not been demonstrated in all infectious diseases, hence we are not authorized to consider these organisms as the *sole* agents of infections. M. Bouchardat thinks that "if organic liquids in which no micro-organisms are found have contagious properties, either the organisms have

escaped observation because of their tenuity, or the fluids contain organic poisons."

In confirmation of the theory that disease bearing germs cannot be rendered innocuous by dilution with air, Prof. Bouchardat remarks: "It is possible to modify micro-organisms by varying the external conditions around them; but if they become infectious after having passed through an infected medium they become practically disease germs, and *there is no reason why the process should not continue.*" Col. Waring's attempt to escape from this proposition by declaring that these disease germs, "supposing them to be detached from the walls of the sewer and to float in its atmosphere, would be relatively so few and are always so buoyant that the feeblest movement of the column of air would transport them without the least difficulty, as mosquitoes are carried by wind, and a whale would be carried by a torrent," appears to me to be, as a learned authority once observed, "one of those consecutors which are so intimately and evidently connected to or founded in the premises, that the conclusion is attained *quasi per saltum*, and without anything of ratiocinative process, even as the eye sees an object immediately and without any previous process."

But grant that disease germs are diluted by atmospheric air and are carried, as Col. Waring says, like mosquitoes by wind, does it follow that they are entirely destroyed or become altogether innocuous? By no means! They may be reduced in number by "dilution," but not in virulence, and are therefore simply transferred from one locality to another to exert their baneful effect wherever they may lodge, as a mosquito will bite in any locality.

Col. Waring should have guarded this weak point in his argument. He is undoubtedly an excellent engineer, but he does not succeed as a medical logician.

His statement that using sewage for irrigation purposes has been "wonderfully successful *wherever applied*," is to me simply incomprehensible, especially with reference to the Berlin irrigation fields, which I am positive have proved a failure. I was not permitted to visit the "fields" myself, the interdiction, so far as strangers are concerned, being peremptory, on account, it is said, of their fearful insanitary condition. They are, as I was credibly informed, already over-saturated, and the authorities, both city and state, are bestirring themselves as to what shall be done un-

der the circumstances. I was also informed by prominent citizens of Berlin last summer that a pestilence was feared unless speedy relief was afforded, either by increasing the area of irrigable surface or adopting another system of sewerage, and several commissions have been appointed to look into the matter.

But my surprise was still greater when I read the statement of Col. Waring that he had himself visited the sewage irrigation works at Paris, among others, and found them "wonderfully successful." This statement is, if possible, more astounding, *me judice*, than his representations in regard to the Berlin irrigation fields, inasmuch as the latter, like those of Croydon, were *for a time* looked upon with some favor, whereas the Paris "fields" have been a source of nuisance from the time the first "regulator" was laid, up to the present time, and have never been regarded as a success, except in so far as they served to divert the sewage flow from the Seine, which was simply transferring the evil from one locality to another; not curing it.

The observations of Col. Waring in reference to these works certainly do not coincide with the experience of the municipal authorities of Paris and the communities in the midst of which these irrigation fields are located. In 1866 the first experiment with irrigation fields at Paris was made, and the peninsula of Gennevilliers, and subsequently the barren wooded lands of St. Germain were selected for the purpose. It was estimated that some twenty thousand acres of irrigable surface would be required to absorb the total sewage of Paris, which amounted to about three hundred thousand cubic yards in twenty-four hours. "At first the 'Villegiature,' who owned or occupied and cultivated the lands proposed to be utilized in irrigation, regarded the scheme as an element of certain fortune, relying upon the statement of the minister of public works that the land would be enhanced in value from one hundred and fifty to four hundred and fifty francs per hectare; but in a short time after the inauguration of the system they were overdosed by sewage, and began to demand, at first, that the flow be stopped for one day, then for a week, and finally for a month, and even longer periods, in order that the land might absorb that which was already upon it. As this could not be done, the lower lands were transformed into seas of sewage, and many cellars were overflowed by the filthy liquid, which on some of the farms even rose above the fences. A great deal of sickness was

produced, and the peninsula of Gennevilliers is still plagued with fevers, which had been hitherto unknown. Such were the evils experienced, that public inquiry into the facts resulted in bringing to light an almost unanimous opposition to the system." *

A commission appointed by the prefect of the Seine from among the general council of the department arrayed itself vigorously against the disastrous consequences of the irrigation works. They say that "the project has not succeeded in freeing the Seine from the evils of sewage pollution because the surface set apart for irrigation purposes is insufficient, but it has destroyed one of the richest districts in the department of the Seine, by introducing an intolerable nuisance and much sickness among the numerous and luxurious villas which adorn the locality. Of the thirty-two communities consulted, twenty-seven protested energetically against the continuance of the works, while the remaining five, viz., Argenteuil, Ecquevilly, Meulan, Verneuil and Versailles, were too remote to take an interest in the question, or were only interested in excluding the sewage from the Seine."

In the communities most interested, nearly 8,500 citizens signed a petition protesting against the continuance of the nuisance, and the residents of localities where the irrigation system had not yet been extended, looked with terror upon its encroachments. This terror was particularly participated in by the residents of "the park," where there is an immense collection of costly villas, on the borders of the beautiful forest of St. Germain. So great, indeed, is the opposition to the works that even the director of public works of Paris and the engineers of the city, who at first so earnestly favored the project, now advise an entire modification of it, which provides for a flow of the sewage upon the lands only at such times as it may be needed. At all other times the waters of the sewage to be drained off or purified and discharged by a canal into the river or the sea; the solid matter to be preserved or utilized for agricultural purposes. This, it will be observed, is not the "irrigation" under "easy control" which Col. Waring speaks of, but a purification of the sewage water which is diverted from the irrigation fields and the solid matter subsequently utilized as contemplated in the Liernur system. Such are the modifications deemed necessary by the director of public works and the engineers of

*See article on The Sewerage of Paris, by M. Villet, in *Revue des Deux Mondes*.

Paris, which is conclusion that they do not consider these works "*wonderfully successful*."

In speaking of the sewerage of Paris, M. Aubry says: "Irrigation exacts an enormous surface on which it instills insalubrity, or at least certain causes for insalubrity which extend to the very gates of Paris, in the midst of a luxuriant and beautiful country where property is condemned to an inevitable depreciation in value; it mutilates a forest which offers to a numerous population resources and comforts, and that in a time when throughout all France there is complaint of the destruction of wood-land which the state has interposed to protect. Finally, it does an injustice to a large agricultural interest, at a time when agriculture has the most pressing need of encouragement and aid."

In the face of such testimony will Col. Waring longer maintain that the irrigation works at Paris are a "wonderful success?" The works at Berlin were, I think, only established in 1876, ten years after the Paris works, and I venture the prediction that they will be abandoned long before they reach the present age of the Paris works.

I would recommend to Col. Waring and those who wish information on the subject, the perusal of a report of Privy Councillor Schultz, chairman of the Berlin Sewerage Commission,* containing an exposé of the trouble and expense experienced with "water carriage and irrigation" at Berlin, and also official information about the Liernur system by the city authorities of Amsterdam.

We come now to consider what Col. Waring calls "Dr. Chancellor's panacea"—the pneumatic system of Liernur, which, in a former paper, I have described in detail, and which Col. Waring seems inclined to "damn with faint praise."

The chief objections urged by Col. Waring against this system are:

1. *That it has not been practically applied, except for the removal of the contents of water closets.*

This is in a measure true, but Col. Waring admits that there are mechanical arrangements for carrying out the whole of the work, which he says, "indicate a very high order of ingenuity." But while it is true that these "collateral devices," as he terms them,

* "*Anhaltspunkte zur Beurtheilung der Canalisationsfrage*," Berlin, Weigandt, Hampel and Parey, 1880.

have not been "practically applied," they have nevertheless been *experimentally tested*, and found to be thoroughly practicable and efficient in all their details, as will appear from the fact that the city of Amsterdam, after ten years of experiment and experience, has finally adopted the system in its totality, including all "collateral devices," and in addition to the twelve thousand or fifteen thousand houses which already connect with it, all new buildings within its limits are compelled, by order of the authorities, as is also the case in Dordrecht, to adopt it. In the former city, plans were being rapidly executed last summer for applying the system on a large scale, with a central station, where all the material will doubtless be eventually manufactured into "poudrette." This station consists of a substantial stone building, in the suburbs of the city, which contains the engines for working the pneumatic pumps, and all the machinery and appliances for operating the system. The experiments heretofore made at Dordrecht have demonstrated the fact that the great value of the system in a hygienic point of view consists in destroying completely all micro-organisms inimical to health, as well as the virus of contagious maladies contained in excretal matters, by the combined action of heat and acid. The fires of the boilers are so arranged as to burn all the air coming from the pneumatic pumps, as well as the bad emanations from other parts of the system.

The fact that Capt. Liernur's first experiments were not a *complete success*, and did not accomplish all that could be desired *instantly*, is no reason why he should be deterred from the field of progress and improvement. Not a year passes which does not afford fresh illustration of the value of science: which does not show by some new and unexpected application, the inexhaustibleness of its power to lessen the evils which are incident to man, and to add to the substantial happiness of his condition.

2. *That the closets are not satisfactory.*

When Col. Waring examined the system in 1875, it was at a time when the works were designed solely for testing the possibility of removing simultaneously out of a number of houses, by means of a single "main," fecal matter in a far more concentrated state than common sewage. It is reasonable to suppose that within eight years great improvements may have been made, and as I know, from a personal inspection of the system in August, 1881, have been made. The

system now allows the application of water closets with the use of all the water required for cleanliness and health. I found the closets exceptionally free from odor and extremely clean, especially in the better classes of houses; and even the *air closets* appear to give entire satisfaction to the people and the authorities. I could detect no more odor in them than is usually found in well kept water closets in America. In speaking of these pneumatic closets, one of the most eminent engineers of Holland, M. de Kops, says: "When they are properly constructed these closets are inodorous to such a degree that the people of Amsterdam do not hesitate to place them within their houses without the least communication with the outside air, except by a small ventilating tube. *They are perfectly inodorous.*"

I also saw them in operation in the grounds of the "International Exhibition" at Amsterdam, where they were in constant use by thousands of careless people, of all sorts and sizes and conditions and nationalities, from the fastidious Frenchman to the filthy Fejee Islander, and they were not offensive in a single case. But a still more striking illustration of the popularity of the system is the fact, as I was informed by the alderman of public works at Amsterdam, that landlords or agents having houses for rent would, as a great recommendation, advertise that they were "sewered by the Liernur system," which, in that city, is considered a great desideratum in point of health and comfort.

3. *That the experiments in dedicating the products so as to make a dry manure, have not been an economic success, and the plans have not been put into practical operation in Amsterdam.*

In all technical combinations and great inventions, the *principles involved* remain the same whether they are carried into execution or not. The following extract from an official report of the mayor and aldermen of Amsterdam, dated August, 1880, will explain why Capt. Liernur's plans for the utilization of fecal matter had not, up to that time, been carried out in that city. The report says:

"In order to utilize the material at present obtained, it has been decided to concentrate it by partially evaporating the water, using the exhaust steam of the air pump engines to furnish the heat necessary for the purpose, and to reduce this concentrated mass to a compost through mixing it with street dirt and house rubbish, thus disposing at the same time of these latter substances. *The selection of this plan is based upon the agricultural peculiarities of*

the surrounding country, those offering a more ready market for such sort of compost manure than for poudrette."

As to the advisability of Capt. Liernur's particular method of utilizing the material in question, in comparison with all other modes, there can scarcely be a doubt. The method is based upon the theory that, as it is the duty of towns to get rid of their offal in such a manner that no nuisance can arise from it to others; it is also *their interest to give it such form and properties as to find ready buyers for it, without being compelled to submit to grievous sacrifices.*

When in Amsterdam I obtained a small jar of this "poudrette," which was manufactured at Dortrecht. The agricultural value by analysis, according to the component parts, is estimated in Europe at about \$48 per ton, and I understand that Prof. Liebig, of this city, who has examined the specimen, places even a higher value upon it.

In discussing this question Dr. Alexander Müller, Professor of Agricultural Chemistry, Berlin, says: "The high agricultural value of this manure cannot be doubted. It contains all the ingredients required for the production of human food, for it is well known that all excremental matter is capable of growing the food required for the organism it was produced by, and the Liernur process consists solely in withdrawing from the fluid matter it collects its *superfluous water*, without losing anything of value. The poudrette contains therefore whatever the excreta themselves contained of manure substance, the percentage of the various ingredients depending upon the habits of the people which produced them, and the food they consumed."

Below will be found an analysis of the "Liernur poudrette," obtained from Mr. Adam Scott, who Major Latrobe, in his paper, quotes as authority against the Liernur system, and therefore, it cannot be considered as a prejudiced statement:

ANALYSIS supplied by ADAM SCOTT, Esq.:

| | |
|----------------------------------|-----------------|
| Water..... | 22.5 |
| Nitrogen as ammonia..... | per cent., 4.26 |
| " in organic combination..... | " " 2.44 |
| Phosphoric acid..... | per cent., 6.70 |
| Kali (potash)..... | " " 1.6 |
| | " " 3.37 |

VALU^E.

| | s. | d. |
|-----------------------|----|----|
| Nitrogen..... | 11 | 2 |
| Kali..... | 6 | 11 |
| Phosphoric acid | 1 | 0 |

19 1 per 100 kilos. of manure,
equal to £9 10s. 10d. per ton.

As additional evidence that the Liernur "poudrette" is a valuable manure, and will prove a financial success, I give below the analysis and report of Mr. Alfred Sibson, Professor of Chemistry in the Royal Agricultural College, London :

LABORATORY. 11, EATON TERRACE, ST. JOHN'S WOOD, LONDON, N.W.

| | |
|--|--------|
| Moisture | 15.34 |
| Nitrogenized organic matter and Salts of Ammonia*..... | 64.13 |
| Phosphates and Oxide of Iron, containing Phosphoric Acid equal to Phosphate of Lime 3.14..... | 5.40 |
| Alkaline Salts, &c. | 11.33 |
| Insoluble matter..... | 3.80 |
| | 100.00 |

* Containing Nitrogen..... 8.30
Equal to Ammonia..... 10.08

" This is an excellent manure, containing, as will be seen from the above analysis, no less than ten per cent. of ammonia, with three of phosphates and other constituents of lesser value. It is superior to any sewage manures or similar products now in the market, since, from its being prepared from the actual excreta, it necessarily contains the whole of the fertilizing matter well known to be present in those substances, especially in the liquid portion. A little sulphuric acid only is added for the purpose of fixing the ammonia, and the pulverulent condition is attained by drying merely, without the aid of absorbent materials; hence the concentrated product represented by the above analysis is obtained.

" This sample is very suitable as a corn manure, and for all purposes for which guano and other ammoniacal manures are commonly employed in agriculture; and if prepared on the large scale of this, or even lower quality, cannot fail in my opinion to meet with a ready sale, as the demand for such manures, espe-

cially those of a nitrogenous character, is at present very large and steadily progressing.

"I consider this sample of special interest, inasmuch as I am informed it is obtained by a system now in successful use at several towns on the continent by which the solid and liquid excreta are removed and collected without the use of separate receptacles for every house, the numerous difficulties connected with the removal of which by hand having always proved a bar to this mode of dealing with sewage.

"If the present system therefore overcomes these difficulties of collection, and meets the sanitary requirements of the case, and at the same time allows of the production of a manure of this character. I think there can be no doubt of its commercial success if introduced into this country."

ALFRED SIBSON, F. C. S.

4. *That the putrescible matters of household or kitchen waters cannot be removed by straining.*

A series of experiments on London sewage has recently been carried on at the northern out-fall by the metropolitan board of works, under the immediate supervision of one of the board's officers, for the purpose of testing the possibility of purifying sewage, by precipitation and filtration, with the result of giving "an effluent perfectly clear and tasteless, in which fish can live." Analysis of the effluent showed that the "remaining solid was not higher than is sometimes found in potable waters, and more than satisfying the requirements of the rivers pollution prevention act." I therefore conclude that Col. Waring is "wrong" when he states that: "However well we may strain household wastes, and however much we may dilute urine, they will both become active sources of offense when putrefying in the waters of a harbor."

The arrangements made by Capt. Liernur for purifying the house waste is at once simple and effective. Prof. Müller, the distinguished German chemist, who examined the process and the effluent says: "The result is a liquid, which can hardly be called contaminated, and leaves no sedimentary deposit. Its level can rise and fall without polluting the town air, and the impure matter it contains is so little, and may be diluted so easily and homogeneously, that in most cases river pollution is quite out of the question. In fact this water is less impure or dangerous than the effluent, which is practically produced by surface irrigation."

"Should, however, a still greater degree of purity be demanded," continues Prof. Müller, "it can be easily attained. After removing the little quantity of suspended matter it still contains, by passing the water through any porous substance, the extraction of the organic matter in solution can be left to the *micro-organisms* in the water itself, through the agency of which the so-called 'self-purifying' of water always takes place; these organisms consuming the organic matter in question, as food."

Capt. Liernur makes use of "intermittent filtration" through beds of gas-coke, which he afterwards uses as fuel for his air-pump and poundrette apparatus; and it has been demonstrated by analysis that the effluent from the household or kitchen waste, after passing through his filters or strainers, do not contain more than .001 or at most .004 of nitrogenous matter. They are, therefore, much less obnoxious to the public health than the waters of many rivers, which in their course are exposed to various sources of pollution.

By the Liernur system the sewer serving for house and rain water is not only kept free from fecal matter, but also from kitchen waste, manufacturing refuse and street dirt; and as the other pipe of the system, which carries off the excretal sewage, works by "suction," and is, therefore, not only *per se* sealed air-tight, but keeps itself so, it is evident that this system keeps air, soil and river practically free from pollution, by means which are simple to construct, convenient in use and highly effective.

This is a merit no other system at present known can lay claim to, not even the so-called *separate water-carriage system*; for by this arrangement the rain-water sewer is not kept free from street dirt, manufacturing waste, stable gullies, etc., which are a serious source of pollution, not only of harbors but of town air. Another serious evil of the "separate," or small pipe water-carriage system, is that the household sewage, including excretal matter, needs cleansing by irrigation or some other costly means, or it will pollute the water into which it is discharged. The loss to the agricultural interests of the country, as has already been shown, will also be very great.

But if the effluent from kitchen waste, after thorough precipitation and filtration by Liernur's method, will be still "an active source of offense in the waters of a harbor," what shall be said of Col. Waring's small pipe water-carriage system, which dis-

charges not only the *unfiltered kitchen slops, but also the entire excretal sewage* into the nearest stream? If, as Col. Waring alleges, "the unmistakable stench in the bay of Naples is caused *only* by street wash and household waters," what is to become of our beautiful Chesapeake bay when all the sewage of Baltimore is emptied into it through Col. Waring's outlet sewers?

"Water," says Prof. Muller, "in contact with fecal matter becomes itself contaminated, without making the latter less dangerous, and favors rather the process of putrid fermentation. The intended effect would only be produced, if the solid excrements were *highly comminuted and homogeneously mixed with large quantities of water, and this was again averted*. Under these conditions a dilution of 1 in 10,000 would *perhaps* suffice. But in water-carriage sewers, the dilution is at the utmost only 1 in 200, and the 'solids,' far from being homogeneously mixed with the water, float in fragments more or less large on or near the surface. These fragments are mostly crowded, through the action of the current, towards the edges of the stream, leaving thus by virtue of its adhesive power, at a falling sewage level, a coating of excrementitious slime on the sides of the sewer. This coating putrefies very soon, or, which is the same, becomes a firm mass of *micro-fungus vegetation*, the minute spores of which are readily taken up by the sewer-air by virtue of their extreme movability, and this air is mechanically pressed out of the sewer by every rise of the sewage level. Thus, the atmosphere we live in and breathe, is daily polluted with germs, which are known to be inimical to health, and may be the carriers of positive contagion, constituting also, most probably, the poisonous agents which experience has taught us to fear in the so-called sewer gas.

"Sanitarily therefore, the water-carriage system is a *decided mistake*, this being due to the effect of water upon putrescible matter, and also of the effect of current water with fluctuating levels upon floating bodies."

5. *That the system of Liernur is expensive, both in construction and maintenance.*

The high working expenses which attended the first experiments of Liernur were not attributable to the system, but were due to the circumstances, that in Amsterdam it was applied to various small parts of the city, lying far apart from each other, in a temporary fashion, and without comprehensive plan, as will be presently

shown. The consequence was that most of these small districts were supplied, each with its own pumping station, and that a steam tug, with pneumatic apparatus, had to be provided for others, thus making the cost of working very much higher than it will be when the works now in course of construction are completed, and the various districts are joined by a common pneumatic main, and the vacuum power concentrated in one engine-house. It should be remembered that Capt. Liernur's plans were not officially adopted by the municipal authorities of Amsterdam until December 21st, 1879, and the work of making the system permanent was only begun in 1881, after the crucial test of ten years experiment.

Referring to the reports of the high cost of the system, Von Eulenberg, Chief Privy Councillor of Sanitary Affairs to the Prussian Government, says: "I can state, upon the authority of one of the most eminent engineering firms in Germany, that the estimates hitherto made upon the working of the pneumatic pipe system of Liernur, are based upon premises which are wrong altogether, resulting in figures not less than *seven times too high*. The system embraces, unquestionably, all that technically and financially could be desired for a good arrangement for the removal of impure fluid, and it deserves every recommendation, since engineers of experience and respectability officially declare it to be *easy to construct, and cheaper in working, and first cost* than the ordinary modes of water carriage sewers, which have been the source of so much perplexity and trouble, besides being sanitariously dangerous."

In referring to this question, Col. Waring says: "The cost of running the Liernur works (in Amsterdam) in 1880 was \$10,858 for a population of twenty-seven thousand nine hundred and forty-six, *being equal to thirty-nine per cent. per head*." In the official report of Dr. A. Schultz, chairman of the Berlin sewerage commission, December, 1880, he says: "In a quarter of Amsterdam of about ninety-four acres, the net work of fecal sewers, with its engine-house or air-pump station and everything belonging to it complete, has cost per metre (i. 1-10 yards) of street not quite \$5. The total cost of working this quarter of the city, for fuel, oil, wages and repairs amounts to \$890, which, divided over a population of thirteen thousand eight hundred and sixty persons, *makes about six cents per head per annum*." That such a discrepancy should exist, in estimates for the same year, between two

gentlemen of scientific attainments is quite astonishing; but as the statements in Dr. Schultz's report are based upon replies which the mayor and council of Amsterdam returned to two series of questions which he addressed to them, as well as his own personal observations made upon the spot, it is fair to presume that Col. Waring's estimate was based upon incorrect information furnished him, or at least upon premises altogether wrong.

My own personal information, derived principally from the municipal authorities of Amsterdam with whom I conferred last summer in reference to the workings of the system in all its details, coincides so nearly with the statements of Dr. Schultz, that I must believe Col. Waring has unwittingly fallen into a great error, as he unquestionably did in reference to the irrigation systems of Paris and Berlin.

The chief engineer of the works stated that in the quarter of the city, between the Wetering and Utrechtsche, which he took me to see, and which forms as it were a district to itself, the expense of service, comprising also the interest on the capital of construction was about thirty-five Holland or fourteen American cents per head per annum, which is only about six and a-half to seven per cent. per head for working expenses.

The entire expense of collecting, transporting and converting the material into a dry "poudrette" for commercial purposes may be stated as follows:

COST PER PERSON PER YEAR.

| | |
|---|---------------|
| For Evaporation..... | \$ 45 |
| Sulphuric Acid to fix Ammonia..... | 12 |
| Interest on cost of Evaporating Apparatus, 5 per cent. on \$1 60..... | 08 |
| Repairs of Apparatus, 10 per cent. of \$1 60..... | 16 |
| Miscellaneous expenses..... | 05 |
| Total..... | \$ 86 |
| To which add working expenses and interest on Capital of Construction | 14 |
| Gives a total per person per year of..... | \$1 00 |

Against this expense we have the revenue derived from the "poudrette," which contains eight per cent. nitrogen, two and a-half per cent. phosphoric acid and three and a-half per cent. potash, the market value of which is at least \$2 per hundred, or

\$2 per annum per person, as each person furnishes an average of 100 pounds per year of dry poudrette.

We may, therefore, state that the entire expense of construction and operation will not only be re-imbursed by the "poudrette," but a handsome profit will also be realized from this source alone.

The expense of the service in the three principal districts, of the city of Amsterdam with an aggregate population of twenty-three thousand two hundred and thirty-nine people is given in the report of the chief engineer for 1882 as follows :

| | |
|---|-----------|
| Superintendence..... | \$ 156.60 |
| Labor..... | 1,187.40 |
| Fuel, grease for machinery, etc..... | 628.80 |
| Repairs of Machinery and Conduits | 248.49 |
| Gas..... | 23.48 |
| Water for boilers..... | 81.84 |

\$2,326.61

Deduct amount paid by house-owners for cleaning house-pipes... 95.90

\$2,230.71

This will make for the twenty-three thousand two-hundred and thirty-nine inhabitants of these three districts an average of nearly ten cents per inhabitant per year, which will be notably reduced when the various systems are joined to the central station now in course of construction. It is by no means a fair thing to include in the estimate the remote and outlying small districts, which are supplied each with its own pumping station, and steam tugs with pneumatic apparatus. It stands to reason that the present high working expenses of these will be greatly reduced after the completion of the works, when the various districts are joined by a common pneumatic main, and the vacuum power is concentrated in one engine-house, and without the necessity for steamtugs.

That the system has attracted and is attracting favorable attention in Europe will appear from the following reply of the Royal Ministers of State of the Kingdom of Prussia, recently made to a communication from His Honor L. Schwartzkopff, privy-councillor of commerce, Berlin. It will be observed that the sanction of the system by the Prussian government is based upon the judgment of the "Royal Scientific Commission for Sanitary affairs :"

BERLIN, April 20th, 1883.

"Your Honor having submitted several proposals relating to Liernur's system of sewerage towns, dated 1st and 16th November, 1881, and the 16th March and 17th July, 1882, asking the government to declare its opinion of the completeness and value of the said system, we take pleasure in replying that, in consideration of the great importance of this question for the sanitation of towns, a most exhaustive examination of the system has taken place and that the desirability of a speedy opportunity for its application in its entirety has been repeatedly manifested.

"Seeing that the plan, as designed by Captain Liernur and submitted to us, for the systematic sanitation of towns, comprises, besides sub soil drainage, the removal of the human excrements (feces and urine) and the meteor-water, household slops, and manufacturing waters in *separate* conduits, we have had, with reference to our regulations of sanitary police, every motive for having it examined by competent judges:

"This was done by the *Royal Scientific Commission for Sanitary Matters* and resulted as follows:

1. 'The removal of human excrements (feces and urine) can by means of the proposed subterranean conduits, unquestionably take place *without* pollution of the air and the townsoil.

2. 'A waterspige in the closed sufficient for preventing pollution of air in dwellings is perfectly compatible with the demands of the system.

3. 'The mode of reduction of the human excrements (feces and urine) to manure-powder for purposes of agricultural utilisation is *perfectly innocuous*.

4. 'Through the treatment of the household and rainwater, as proposed by the system, and the cleansing of industrial liquids by the respective manufacturers themselves, the removal of these fluids by subterraneous conduits can take place without polluting the town-soil or the air.

5. 'Captain Liernur's method for cleansing the fluids, mentioned Sec. 4, will possibly be sufficient to give them the required degree of purity for being discharged in public streams without sanitary objection. Should such not be the case, other methods may be employed at least for a discharge into the larger rivers.

6. 'Captain Liernur's system allows, when applied in the com-

plete state as designed by him, a sufficient control on the part of the government as to its working from a sanitary point of view.

7. 'So long as the results held in prospect are actually obtained the application of the system is permitted.'

"To this judgment of the *Royal Scientific Commission for Sanitary Matters* we give our adherence in every respect. We meet in doing so the proposals made to us, so far as allowed by considerations of state and sanitary police, and give full liberty to make of this declaration all public use you may deem requisite.

"Leaving the further development of the matter to your Honor we fail not, respectfully, to add that we will be happy to see your meritorious endeavors, in so important a question as the sanitation of towns, crowned with success."

(Signed.)

VON PUTTKAMER, *Minister of the Interior.*

MAYBACH, *Minister of Public Works.*

LUCIUS, *Minister of Agriculture.*

VON GOSSLER, *Minister of Educational and Sanitary Affairs.*

"To His Honor

L. SCHWARTZKOPFF,

Privy Councillor of Commerce, Berlin."

Finally, Col. Waring seems to think me as ignorant of physical laws as he would have the world believe I am of the principles of sewerage and agriculture. After enumerating many points on which he thinks I am wrong, he says: "He is wrong in supposing that a man can lift himself by his boot-legs." Whether Col. Waring or I represent that metaphorical personage, who spent his life in a vain endeavor to make dominoes out of bonny-clabber, the public must be the judge. Certain it is, I should not consider such an undertaking more Quixotic than the attempt to convince an enlightened community that "water carriage" is the only "panacea" for sewage evils. Of one thing, however, the public may be convinced, and that is, that Col. Waring is as much in love with his own ideas as Cobbett was with "Indian Corn," or Charles Lamb with "Roast Pig." This is not strange. It is a property of genius, not only to be in love with its chosen pursuit, but at the same time to make others in love with it. When Col. Waring loves he loves with all his heart

and soul; the contemplation of the object of his affections warms his imagination into a glow, and he grasps it with the athletic power of a man to whom nature has been liberal in both physical and intellectual gifts. Like all true lovers, too, he finds no pleasure in aught else; he turns away with indifference, if not contempt from all but his favorite object and resents with energy the solicitations of any other claimant upon his attentions.

